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| **CODEDU’s Teachers’ Training Curriculum** |
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| **Section 1: Introduction to New Teaching/Learning Methodologies** |
| **Subject:** Education | **Duration (in hours):** 45 min |  |
| **Target audience:** Upper-Primary and Secondary School Teachers |
| **Training methodology:** Online learning |
| **Level (and cycle, if applicable) of the learning experience: /** |
| **Assessment method: /** | **Form of participation in the learning activity:**  |
| **Expected Learning outcomes:** • Understanding basic principles of innovative learning methodologies* Understanding the basic principles of PBL
* Understanding the basic principles of the Flipped classroom method
 | * Online modules
 |
| **Prerequisites needed to enrol in the learning activities (if needed): /** |
| **Supervision and identity verification during an assessment:**  |  |   |
|  • Unsupervised with no identity verification.  |   |  |  |
|  • Supervised with no identity verification.  |   |  |   |
| • Supervised online or onsite with identity verification.  | X |  |   |
|  ***Key Words***Innovative teaching methods, Project-based Learning (PBL), Flipped classroom, Arduino |

| **Module 1.1** |
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| **Innovative Teaching Methodologies** |
| * + 1. Overview of Innovative Teaching Methodologies

Innovative teaching methodologies benefit from an educational approach that emphasizes **direct engagement and practical experience** in the learning process. It involves **active participation of students, manipulation of materials, and real-world application of knowledge and skills**.The biggest difference between traditional teaching methods and learning through innovative methodologies is in the **involvement of students** in the process; the latter encourages or better say requires **active participation.** On the other hand, traditional teaching methods with the teacher talking and students listening or writing are known as **passive methods**. The differences in approaches result in **different sets of skills** that are gained during both pedagogical methods and levels of in-depth connection that is formed with the studied subject. When students actively manipulate the studied matter or are actively involved in the research, they gain a **deeper understanding** of the concepts being taught, and they memorize the introduced subject better as opposed to listening to a teacher and taking notes about the subject. There are many types of learning methods that fall under innovative learning. They often interact with each other in the sense that one or more characteristics from one method are also applicable for the other and the lines between them are often blurred.Some of the most commonly known innovative learning methods are: **Project-based learning**: Learning that is focused on real-life problems that are being tackled through hands-on projects done by students. **Game-based learning**: Learning that enhances the appeal of games as part of the learning process to increase engagement and motivation. Games used become educational tools that increase students' motivation, knowledge and skills.**Gamification**: This method applies game elements (like scores, levels, badges, and leaderboards) to existing learning activities and can be implemented in a non-game context. A game-like atmosphere that is established encourages participation and competition. **Inquiry-based learning**: Learning that starts with an open-ended question by the teacher or a project assignment that is followed by active engagement of students.**Collaborative learning**: This term includes any activity where learners work together (like PBL for instance).**Flipped classroom**: An innovative approach where students get their first exposure to content before coming to class and then spend in-class time engaging in activities in a dynamic, interactive learning environment.**Blended learning**: a combination of traditional face-to-face classroom methods and online education leveraging technology to enhance learning. **Experiential learning**: learning through hands-on experiences and reflection. All mentioned methods have the following in common: - active learning, - soft skills development, - in-depth learning,- hands-on learning, - real-world connection1.1.2 Benefits and Challenges of Integrating New Methodologies.**The benefits** that come with innovative learning methodologies are closely connected with their characteristics: because of active, hands-on learning and connection to the real world these methods are **engaging and effective**, offer **in-depth knowledge**, and give students more **autonomy**. They also encourage the development of **soft skills**, and because of the use of technologies, they offer more **flexible,** **personalised learning** which leads to **inclusiveness**. The use of technology also allows students to learn how to effectively manage **high-tech tools.** However, no matter how beneficial new learning methodologies are, there are some **challenges** that these kinds of methods bring. Various limiting factors such as **insufficient infrastructure**, **overpopulated classes**, **lack of teachers' self-confidence**, and an excessive amount **of time and effort** required to plan lesson plans or conduct accurate experiments. In research about ICT use in high schools, three barrier factors were extracted that we can also apply to new learning methodologies. Teachers reported:* **lack of support,**
* **lack of confidence** and
* **lack of equipment** (Nikolopoulou and Gialamas, 2016)

Another aspect that we need to consider is the **new role of a teacher** that emerges from these methods. This new role can be seen as beneficial or as a challenge. The teacher is no longer the knowledge holder, but the person who shapes the learning environment, a **mentor and a facilitator**. A teacher's traditional role is reshaped, which can be challenging for some of the teachers. A new role of a teacher means that he or she offers **guidance and support** to students when needed so that they can complete the tasks on their own. This process allows **more one-on-one time** and **various learning styles** can be offered to students to reach the best results.Consequently, because the teacher has a new role, the **teacher-student dynamic** is also changed as it becomes more **collaborative**. New learning/teaching methods encourage collaboration between teachers and students in the development of lessons and projects to leverage student interests and address specific needs. |

| **Module 1.2** |
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| **Project-Based Learning (PBL)** |
| 1.2.1 Principles and Framework of PBLOne of the most broadly used innovative learning methods is project-based learning, also known as PBL. Although some of the ideas and principles of PBL have a longer history (from Confucious and Socrates BC to John Dewey, Maria Montessori and Jean Piaget in the 19th and 20th Century), the PBL as a learning method traces back to 1965, to McMaster University in Canada, more precisely to their medical school department. The main reason for introducing this new learning method was to change the passive learning of medical students to a more **integrated approach**. They wanted to actively engage students through student-centred learning to reflect real-life situations and enhance motivation and self-directed learning skills in students. Since its origins, PBL has gone well beyond the medical school environment in Canada, as it has become adopted by numerous different-level schools worldwide. Let us look at what is it about this approach that makes it so appealing.The main principles of PBL that were originally set out, remained the same: **it is a student-centred learning method that is based on projects.** PBL is an inquiry-based and problem-solving methodology in which students are engaged in solving real-world related problems. It is one of the methods that is based on the principle of learning-by-doing or learning-by-building; students are actively engaged throughout the whole process, especially through the implementation phase. As with all problem-based courses, PBL also **starts with exposing problems** rather than with an exposition of disciplinary knowledge. Students move towards the acquisition of **knowledge and skills** through a staged sequence of problems presented in context, together with associated learning materials and support from teachers. The **interconnection of knowledge and skill** that takes place during PBL is very beneficial because it allows **better knowledge retention** and because of the meaningful and original solutions relevant to the real world, **motivation** in students is increased.In PBL, the students are collaboratively engaged in planning, problem-solving, and researching over extended periods, preferably from one week to even the whole semester.To sum up, PBL is highly beneficial for students, including those with special educationalneeds, for several key reasons:• **Active learning**: students learn by doing (researching, making projects, actively participating in the process)• **21st-century skills** are being developed, including the so-called 4 C’s: critical thinking, creativity (they are encouraged to find solutions), collaboration (they develop collaboration skills by working in a group) and communication (they learn how to present the final product, and strengthen their communication skills in a group). Decision-making, planning, and responsibility are also some of the skills that are being tackled. • Enhance **technical skills**: specifically, in the case of Arduino, students learn the concepts of coding.• **Motivation** towards learning and autonomy.• **Connection to real life**, thus making the results more relevant.• Encourages **diverse learning**: learners can learn at their own pace and with the material they like best.**Challenges** faced when applying PBL to school environments are similar to those stated for all innovative learning methods and include: **lack of equipment, overpopulated classes, lack of teachers' confidence, lack of time and lack of support for teachers.** **PBL and Arduino:**With its specifics mentioned in previous lines, PBL is a great way to integrate multiple subjects, and teaching Arduino can be a great opportunity to create **interdisciplinary projects**, involving science, technology, art, history or foreign languages. This allows students to apply their coding skills in practical ways, building real-world prototypes and gaining hands-on experience. Literature about the connection between PBL and Arduino reveals that PBL is the most commonly used methodology for incorporating the Arduino board into teaching in the context of STEM subjects. (García-Tudela and Marín-Marín, 2023, p.1)1.2.2 Designing and implementing PBL in the classroom (creating lesson plans, and assessment strategies)In PBL, the frontal lecture is still in use but is no longer the privileged method of the instructional process. Students are engaged in exploring through a process of inquiry and collaboration. They ask questions, build up hypotheses, research, collect, and analyse data independently; they collaborate by sharing ideas and creating products. For PBL to be successful, one of the key components is a **well-prepared teacher**. To help you with this important part, let us look into how to create an **effective lesson plan** by following these 5 phases:**1. Project planning:** In this phase, the teacher defines the project’s **main theme**, creates a **driving question** that students will explore throughout the project and **sets goals** that need to be achieved by students. Ask yourself: what do we want to accomplish with this project?The **theme of the project** should be broad so that it involves an interdisciplinary approach but at the same time specific enough to allow students to focus on a particular problem or phenomenon.The question addressed at the beginning of the lesson is the framework of the entire PBL project so teachers have to carefully choose **the driving question**. The learning process starts with a complex question or problem. Here are some general guidelines on what to pay attention to when creating the driving question: it should be open-ended, connected to the real world, challenging enough (but age-appropriate), and relevant to the standards addressed by the project while at the same time allowing multiple solutions. **Goals (and outcomes):** they should be aligned with the theme of the project. They should encourage different skills. Bloom’s taxonomy scale can be used with verbs that align with what should be achieved: identify, explain, create, analyse, evaluate, and design.SIMPLE EXAMPLE: Sound-based art installation controlled by the codeTHEME: Science of the Sound: students will create an art installation that involves sound and mathematical patterns with the help of coding. DRIVING QUESTION: In what way can music visualise mathematical patterns and symmetry?GOAL: Creating digital materials that integrate art and science, raising awareness of the connection between art and science, and applying scientific concepts through artistic projects.The phase of planning the project is also the time to think about the project timeline and draft some activities to build up your project together with your students. Plan on how much time you want to dedicate to **students' individual research** and how much to **frontal lesson**. Tip: when planning, try to balance frontal lessons and practical activities, allowing students to apply the content knowledge immediately after acquiring it.**2. Research and idea development:** this phase is mostly done by students with the teacher offering support and guidance. The objective of this phase is to encourage students to do the research using various sources of information (literature, talking to experts, visiting museums, etc.) and find answers on their own.Teachers should **brainstorm** with students about what kind of resources they should look into, teachers can **divide students into teams** that will focus on specific topics, and encourage students to document their findings in a structured manner and **collect data** from them.Tip: make sure that multiple perspectives are being covered and that diverse sources of information are included, if the workflow in teams is not established, the teacher can assign roles within each team (researcher, presenter, etc.)**3. Implementation:** thefocus of this phase is on the execution of project activities. This is the phase where students carry out the activities they were planning in the previous phases. This involves creating prototypes, videos, performances, etc. Guidance from a teacher is especially important in this phase. Teachers should **plan activities** by organising material and assigning roles. When the **implementation** takes part, the teacher should document the process and conduct activities with students. The final step of implementation should involve **the collection of data and materials** for the final presentation.Tips for teachers: carefully guide students and offer them support (either technical or with resources), allow them to share their ideas, and be creative and innovative. **4. Presentation of results:** this is the phase where students **present** the project’s results, and **discuss** what they learned, this is also time to reflect on the process. Teacher(s) and peers should give **feedback** on the presentation.Students can prepare for the presentation of their results with posters, digital tools, video material, models, art installations, and so on. The presentation can be made in front of the class, school, parents or wider community. After the presentation, discussion and feedback should take place. Tips for teachers: ensure all students are involved in the presentation. Use this opportunity to motivate students for future projects by celebrating students’ success. Try also to find a specific audience which might have a special interest in the topic. The larger the audience, the better your project will succeed! To have a real audience to whom students can present their products and projects adds meaning and value to their work. They will feel more motivated and involved.**5. Evaluation:** in this last phase, teachers are expected to **assess, analyse and reflect** on students’ achievements as well as on the project itself. The assessment should be multilayered and incorporate an assessment of **content, skills, and student engagement**. Here is a place where teachers can lean on the project planning activity (the first phase) where goals are set. They can look into **knowledge or skills** that students were expected to demonstrate as a result of their engagement in a project.Teachers can: gather reflection from **students**, assess the success of the project according to the **goals** that were established, and gather feedback from **teachers and other students** that were present at the presentation. Developing effective assessment strategies for coding skills requires careful consideration. Moving beyond traditional testing methods to evaluate critical thinking, problem-solving, collaboration, and creativity is important.Assessment is one of the **most commonly reported challenges** teachers face when performing PBL so here are some tips on how to ease this part:* Share your assessment criteria with students and make them part of the process.
* If your students already have experience in project work, invite them to collaborate with you to develop the evaluation criteria together. This way they can reflect on the steps of the project on a deeper level.
* During the lesson, use **formative assessment** to foster the acquisition of both **content knowledge** and 21st-century **skills**.
* you can use quizzes to assess their knowledge and studying methods. In this case, the quiz is not an evaluation test but it's a method to determine their knowledge (and identify possible misconceptions)
* you can also plan **frontal lessons** and Q & A sessions to clarify the doubts and questions of the students.
* If PBL was done by combining more school subjects, a **summative** assessment of individual standards should be provided by the teacher of each subject

What can be assessed in PBL:- persistence- improvement progress- meeting of curriculum objectives- collaboration and teamwork- content knowledge- content application- design successTo sum up, PBL could be a highly rewarding learning method for all participants and with this brief but informative segment, we hope we encouraged you to give it a try in your classroom. |

| **Module 1.3** |
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| **Flipped Classroom Model** |
| 1.3.1 Key concepts and advantages.The flipped classroom model takes a spin on traditional teaching methods and their concept of introducing the subject in the classroom first and then studying it at home. Flipped classroom is an innovative method that goes especially well with the rise of new technology and it probably wouldn’t even be possible without it. Adjective flipped refers to a **reverse sequence of events**: students are first given the material to **study the subject on their own** and are then invited to discuss and resolve questions **in the classroom through different activities** (in traditional learning scenarios this would be called homework). Because they already gained some knowledge about a specific subject before the class, class time can be utilised for achieving a **higher order of thinking** and **skills development**. This process allows students to have an active role in the process and gives them more autonomy. Students are provided with **topics**, **objectives** and **materials** by the teacher. One of the main appeals of this approach is that it allows students to engage with content that needs to be studied at **their own pace**. Because of the reverse situation in a flipped classroom students, following Bloom’s taxonomy, do not display the ability to **recall and memorise** but rather to **understand and create.** (Flipped Classroom in Practice, p. 9)The role of a teacher in a flipped classroom has changed as it is no longer so much that of a lecturer but more of a **guide or a mentor**. A teacher has more time and opportunities to address the needs of each student individually and the different levels of knowledge they possess or the different challenges they face. The flipped classroom offers teachers an opportunity to adapt to individual student learning needs, making this method more inclusive. **Main advantages**: Increased student engagement, better understanding and retention of knowledge, motivation, meaningful learning, increased learning autonomy in students, students with varying learning preferences benefit from this method (Flipped Classroom in Practice, p.13)**Challenges**: In addition to known challenges that are true for all innovative methods, a new challenge occurs in flipped classrooms; for this method to work the way it was meant to, students must do their part at home. They must have **access to the material** (internet and computer access) as well and they have to have the **motivation**. (B. Petty, 2018 Edutopia) There is no direct supervision in the first part for students and they have to have some time-management skills and self-discipline. With its characteristics, a flipped classroom method much like PBL is very suitable to teach **Arduino.** Students can first study about basics of Arduino at home: the teacher can provide material that covers the theoretical overview, they can get familiar with the terminology and how Arduino board is constructed and after they gain some knowledge they can start working on hands-on activities in the classroom where the teacher can explain guide, and support where needed. The Codedu project was created with teachers' and students' needs in mind and materials developed during the project can be also used in flipped classroom scenarios. Material that will be developed during the project can serve as material that is given to students in the first phase when they study on their own and numerous ideas for lesson plans can be used in the second phase that is done in the classroom where students can do hands-on activities. 1.3.2 Tools and technologies to support flipped learning.As said before, a flipped classroom is a method that goes particularly well with technology as it leverages its different tools to enhance learning.**Materials given to students in the first phase**, that are given to them to be studied, are usually in some digital form. Teachers can use **already prepared materials** on their topic that can be found online, on different open educational platforms. There are general ones that you probably already know (and use) where you can search for a particular topic or theme you want to use in your lesson plan like: **Khan Academy**, **edX**, **Open Education Europa** (EUnet), **Google Classroom**, and **OER Commons**, to name a few. But there is also a platform created particularly for **Arduino**, <https://www.arduino.cc/education>, where you can find everything you need to create effective lesson plans; from materials to cloud options where you can facilitate your projects, from support for educators to online learning content. The other option is that teachers **prepare this material themselves** with the help of a vast variety of tools available nowadays for creation. Let’s look at some of these tools and forms that material could take place:1. **Presentation:** A simple yet effective interactive presentation of the chosen topic is still one of the go-to for teachers. It can be done for instance in **Microsoft PowerPoint, Canva, or Prezi.** Teachers should aim to make the presentations informative and attractive at the same time.
2. **Video or animations**: instructional videos are also a very popular and effective way to introduce students to a specific topic. Visualisations of the topic could increase interest in students. Some useful tools: **Animoto, Biteable, Animaker, WeVideo, and Book Creator.** When making a video or animation following these steps can make it easier: planning + adding visual elements + adding sound effects + editing + publishing**.**
3. **Infographics**: A concise summary of the topic or most important information can be designed in the form of infographics to make it more appealing for students. **Canva, Piktochart and Visualize** are some of the applications that teachers can use.

These are just some of the options a teacher has when planning flipped classroom lectures and creating material for the lesson plan.Bibliography:*Flipped Classroom in Practice. Innovating Vocational Education* (2018). Erasmus+ Project. <https://ec.europa.eu/programmes/erasmus-plus/project-result-content/17061004-3280-44bc-81ca-463b3f329b5d/Flipped%20Classrom%20in%20Practice%20EN.pdf>García-Tudela, P.A. and Marín-Marín J.-A. (2023). Use of Arduino in Primary Education: A Systematic Review.*Education Science,* *13* (134). DOI: 10.3390/educsci13020134Nikolopoulou, K. and Gialamas, V. (2016). Barriers to ICT use in high schools: Greek teachers’ perceptions*.**Journal of Computers in Education 3* (1): 59-57. DOI:[10.1007/s40692-015-0052-z](http://dx.doi.org/10.1007/s40692-015-0052-z)Petty, B, (23.7.20218). *4 Tools for a Flipped Classroom*. Edutopia.org. <https://www.edutopia.org/article/4-tools-flipped-classroom/> |

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